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HAVE THE "VERTICALS" MADE GOOD?

By R. N. BUELL.

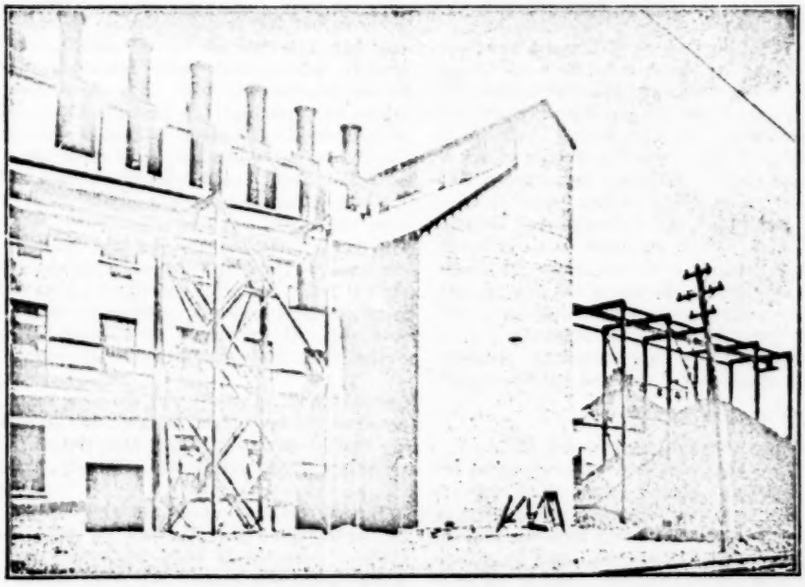
To the gas company contemplating the construction of new, or the enlarging of its present coal gas plant, no greater problem presents iiself than the question as to the type of bench to be installed—Shall it be "Horizontals," "Inclines," or "Verticals?"

The author of this article will not be so presumptuous as to offer an opinion as to which system is best; but by placing comparative data, gleaned from reliable sources, before the readers of the JOURNAL, will let them decide this much disputed question for themselves. That the present status of the various styles of coal gas benches may be more readily understood, a brief resumè of the subject may not prove amiss.

As the birth of Christ marks the beginning of the Christian Era, Stevenson's invention the advent of steam railroad transportation, Galileo's discoveries and deductions the fundation of modern physics, so the students of artificial gas manufacture date their reckonings from the days of William Murdock.

Beginning then from the time of Murdock, with cast iron retorts set in horizontal surface benches, with very shallow furnaces, the construction of coal gas benches, for a period of 50 years or more, underwent very little change, the improvements being very gradual and limited. The principal innovations during this time were the adoption of fire clay retorts of various shapes, in place of cast iron, and the introduction of the regenerative or recuperative furnace, by means of which a larger firebox capacity was available, and the use of properly heated secondary air mixed with the producer gases in the combustion chamber, furnished a much higher degree of heat than hitherto obtainable. A few other minor changes had also been made, such as the substitution of the lever self-sealing mouth-piece lid, for the lime luted screw lid, and the introduction of water, steam and air under the furnace grate bars to minimize the collection of "clinker" in the fire box.

Trials had also been made, in a limited way, with benches of "through" retorts, and power charging and discharging machines had begun to appear upon the market. During the latter part of the nineteenth century various experiments were made with the inclined type of gas bench, which were a distinct innovation, and caused the old conservative gas makers to make forecasts of its ultimate failure. They contended that the charge of coal would clog the retorts, making it impossible to withdraw the coke; that the temperature inside the retorts could not be properly controlled, and that the weight of the retorts would displace the lower outside wall. These calamaties, however, failed to materialize, and the wise ones admitted that the inclines had come to stay. Many authorities claim that the inclined system to-day, with the many improvements recently added, is the best type of bench for plants making from one to two million cubic feet of gas per day.



Ottawa, Canada, Vertical Retort House, and Coke Handling Plant.

While the Horizontal and Inclined Benches were contending for the honors of greatest efficiency, suddenly the infant "Vertical System" loomed above the horizon and claimed hearing. For the past few years Verticals of continuous and of intermittant types have made great strides in popularity and efficiency. The plans and specifications of the Systems have undergone many changes since their introduction, both in line and dimension, and silica retorts and settings in place of fire-clay are now the general usage.

In America the adoption of the Vertical System has been confined to the Eastern States and Canada; but the West and Middle West are studying the situation, and if ultimate results bear out the

	St. Louis.	Springfield.	Ottawa.
1. Type of bench	Horizontal	Inclined	Vertical
2. Date of installation	1913	1905	1915
3. Number of benches	16	5	6
4. Number of retorts per bench	8	9	8
5. Dimensions of retorts	16' x 26' x 16 feet	15' x 23' x 18 feet	$8\frac{1}{4}$" x 2'-9" Top 1'-$6\frac{1}{2}$" x 3'-3" Bottom 20'-$3\frac{7}{8}$" Long
6. Coal capacity of retorts per foot	81 pounds	60 pounds	100 pounds
7. Average gas yield per pound of coal carbonized	5.75 cubic feet	5.00 cubic feet	6.389 cubic feet*
8. Average fuel consumption, per cent.	$13\frac{1}{2}$ to 15	15	15
9. Candle power of gas	16.5	16	.....
10. Calorific value, B. T. U.'s	620	610	535
11. Duration of charge	8 hours	6 hours.	Continuous; coal passes through in 10 hours
12. Method of charging	De Brouwer Machine	Gravity	Gravity
13. Composition of retorts	Silica	Fire clay	Fire clay**
14. Ammonia recovered per ton of coal carbonized	5.75 pounds	5 pounds.	4.5 pounds
15. Tar recovered per ton of coal carbonized	12 gallons	15 gallons	12 to 14 gallons
16. Cost of retort house labor per ton of coal carbonized	$27\frac{3}{4}$ cents ***	.....	.....
17. Scurfing periods	14 days	6 weeks	18 days

*The apparent high yield obtainad in Ottawa may be accounted for by two things: First, the automatic coal scales were found to vary 5 per cent.; Second, in cooling the coke, a jet of live steam is passed into the coke chambers, producing water gas, thus increasing the yield and decreasing the B. T. U. of the gas.

**Combustion chambers lined with silica.

***Does not include superintence or exhauster attendance, but includes cost of handling coal from cars to bins, and coke to outside receiving bins.

claims made by their promoters, the next few years may witness the installation of many new Vertical plants.

Various problems enter into the selection of a system, but the question generally narrows itself down to one of economy. Which system can deliver marketable gas in the holders at the least cost? Of course, there may be various local conditions that influence the final decision. For instance if ground area is limited, the Vertical system has a distinct advantage.

To determine the relative operating conditions, and the results obtained by the three leading types of coal carbonizing plants using retorts, the writer has, with some difficulty, obtained authentic data from some of the largest and most successful gas works in America and herewith presents statistices from three well-known plants, *i. e.* the Laclede Gas Light Company of St. Louis, using the horizontal-through system; the Springfield Gas Light Company of Springfield, Mass., using the inclined system, and the Ottawa Gas Company of Ottawa, Canada, using Glover-West Verticals. No doubt the average gas man will find food for thought in the above tabulated statistics. It may be taken as an accepted fact the abnormal yield of gas per pound of coal carbonized obtained at the Ottawa plant could never be successfully maintained in the States, where the standard of B. T. U. calls for much richer gas.

One pertinent inquiry that may arise in the minds of some who read this article is this: If gas of 535 B. T. U. calorific value is satisfactory to Canadian consumers, why wouldn't a gas of equal value pass muster in the U. S. A.? This and similar questions which the discussion of this subject may have suggested, the writer leaves to those more capable than he to answer, believing that the army of experts giving serious thought to the advancement of the manufacture of artificial gas will eventually produce results now undreamed of, and sure to result in credit to the industry, and to the benefit of the public at large.

Anthracite Coal Production Decreases Slightly in 1915.

Estimates by the Anthracite Bureau of Information at Wilkes-Barre, Pa., indicate that the production of anthracite coal in Pennsylvania in 1915 will show a decrease, as compared with 1914, of about 2,000,000 long tons. The monthly shipments reported, with estimates for December, indicate a total for the year of about 66,382,000 tons, as compared with 68,342,601 tons in 1914. These figures do not include the shipments over the Lehigh & New England Railroad, nor any of the output from Sullivan County. If these shipments, with the sales to local trade and the colliery consumption, are included, the total consumption for the year is estimated at 79,100,000 tons, as against 81,090,631 tons in 1914. Compared with the maximum production of anthracite in 1913-1915 it shows a decrease of 2,600,000 tons. According to reports made to the Geological Survey, the decreased production is due to the fact that, in spite of repeated warnings that a scarcity of fuel would be likely to occur in the winter of 1915, the consumers have not laid in their supply in advance to the same extent of formerly, and the retailers have been slow in placing their orders. In no year since 1901, when the spring and summer discounts were put into effect, has so little advantage been taken of the opportunity to purchase coal at reduced rates during discount months. The production at the mines, however, has been maintained at a rate hardly warranted by the conditions of the market, and the capacity of the storage yards has been taxed to the utmost to take care of the surplus output which should have been in the cellars of consumers or in the yards of the retail dealers.

At the close of the year there is considerable apprehension of a fuel famine among dealers and consumers, and should any serious interruptions to traffic occur, the operators may have some difficulty in relieving the famine, as their storage yards are near the mines and can scarcely be considered more available as a source of fuel than the mines themselves.

The shipments from January to November, 1915, with an estimate for December, are as follows:

	Long Tons.
January	4,734,535
February	4,275,107
March	4,985,398
April	6,486,201
May	5,797,961
June	5,316,102
July	4,934,205
August	5,330,831
September	5,518,771
October	6,505,892
November	6,297,215
December	6,200,000
Total	66,382,218

THE SUBSTITUTION OF HEATING VALUE FOR CANDLE POWER AS A STANDARD FOR GAS QUALITY.

From Paper by R. S. McBRIDE, Associate Chemist, Bureau of Standards, to the International Gas Congress.

A specification of quality for a gas supply should meet the following requirements:

First, It must be a real measure of the usefulness of the gas for the principal uses to which gas is put.

Second, It must permit economical manufacture, including (*a*) use of the most economical fuels; (*b*) adoption of the most efficient processes for generation and distribution; and (*c*) operation with the minimum of financial risk.

Third, It should be clear in all details and require only simple tests for its enforcement, i. e., it should introduce no ambiguity in meaning and no uncertainty, difficulty or undue expense for tests.

In other words, the standard must be such as to give proper regard to each of the three principal interests affected by it; by affording proper safeguards to the users of gas, by placing no unreasonable limitation upon the gas-supplying company, and no unnecessary burden on the official charged with control of the relations between the public and the company.

The Fundamentals in the Relations between Company and Customer.—The community of interest of these two is of first importance, although too large a part of the regulations now in force have been adopted without proper regard for this fact. In practical every day affairs, the largest benefit will come to company and to user, only when the supply of gas is on the most economical basis. That requirement or standard of operation which permits the delivery of the largest amount of service to the user for each unit of cost, is obviously the best for the user, and also most desirable from the standpoint of the company, since it permits it to secure proper return and the maintenance of its property, with minimum expense to the users.

As a general principle, it must be remembered that inducements to capital must be sufficient to bring it into the industry, and that progressive and efficient management must find greater reward than indifferent management is allowed. But the advantages of improvements in the industry, of efficient management, and especially of growth of the industry, must be shared with the public that offers the companies the protection, opportunities, and facilities for operation as public service corporations. There should be a real partnership, in which the public and the companies share.

Results not Methods to be Prescribed.—In many states the public utility commissions have been granted broad authority, but in a majority of cases, only the results to be accomplished by the companies are prescribed, they being permitted to bring about the results by any means they choose to employ. The operating engineer is generally in a much better position to determine the most economical methods of procedure in manufacture and distribution than the regulating body.

There are exceptional cases in which the authorities find it necessary to over-rule the choice of the company and prescribe methods as well as results, but fortunately such cases are rare. Their occasional occurrence, however, justifies the rather large authority granted to state commissions.

What is a Good Gas Supply?—Recognizing the fact that the end rather than the means must be defined in the standards, the regulating official must first determine what is essential to good gas service, or, in other words, what the user of gas really needs. In the ultimate analysis, it is desirable that there should be afforded:

First, Safety for the users of gas and the general public.

Second, An adequate and continuous supply of gas at all times and for all parts of the territory served by the company.

Third, Proper maintenance of the producing plant and distributing system.

Fourth, Fair return to the operating company.

Fifth, Maximum service for each unit of cost to the user.

Sixth, Intelligent conservation of the national or public wealth in coal, oil, gas, and other natural resources.

It is not proper to ignore any one of these six fundamentals; nor can any one of them, except the first, be regarded as more important than the others. Indeed each one is dependent upon the successful accomplishment of all of the others; and it will be seen in the course of the following discussion wherein each of them has a bearing upon the choice of the standard for gas quality.

UTILIZATION OF GAS.

From the time of the first supply of gas for general use, until mantle lights and gas cooking devices became important factors in the utilization of gas, a large percentage of the gas was employed for open-flame lighting, and naturally the open-flame candle power was considered the most important criterion by which to judge the usefulness of a gas supply. The introduction of water gas was also a large factor in encouraging the manufacture of and the demand for a gas of high open-flame candle power. Indeed, the influence of that process and the need of making economical use of gas oil, for which there was practically no other outlet, are still noticeable factors tending to increase the production of high candle power gas.

During the last quarter century there has been notable increase in the variety of uses to which gas is put, and users have increased faster than the population, because of this variety of applications and the lower cost of gas. The mantle lamp, which came into general use about 1890, made large advances possible in the field of gas lighting, so that it is probable that in a majority of places more gas is now used for lighting than was ever used in open-flame lights; despite the large increase in lighting by electricity.

The use of gas for cooking, water heating, room heating and miscellaneous domestic purposes, has contributed largely to the increase in gas sales; and more recently the multitude of applications for gas industrially, has been a large factor in shaping the course of the industry. These changes and developments also affect gas standards.

Legitimate Use of Open-Flame Lights.—The open-flame candle power of a gas is an indirect measure of its value for many purposes, but directly a measure of value only for open-flame lights. The extent to which the open-flame light is properly employed is, therefore, a question of some importance in considering standards of quality. Under ordinary conditions, for the same consumption of gas, a mantle will give from 3 to 10 times the light given by an open flame; and including installation and maintenance, on the basis of total expense to the user, the mantle is generally a more efficient light source. The conditions for which open-flame light is suited are, (1) locations where the light is subject to mechanical shock, (2) where the air is very moist and hence detrimental to the mantle, and (3) where light is needed only at infrequent intervals. The development of a more durable mantle has made it possible to largely eliminate the first of these; and the second is often exaggerated. It is generally found that the "legitimate" use of open flames will not account for as much as 5% of total gas sales.

STANDARDS OF QUALITY.

The Two Existing Standards.—Aside from freedom from chemical impurities, the quality of gas is judged by its heating value and its open-flame candle power. Certain other criteria are valuable in considering its usefulness for special purposes; but up to the present, none of them have been specified in laws prescribing the quality of gas. Indeed it is doubtful whether it would be possible with the present processes of gas manufacture, to control the composition of the gas in one particular or another to an extent desirable for an ideal supply; and to always supply gas that required for complete combustion, a quantity of air fixed within narrow limits, would be beyond the facilities and knowledge now available. It is safe to say that for the immediate future the regulation of gas quality must be based upon the measurement of heating value and of open-flame candle power. How soon other properties may be utilized for rating, it is impossible to say.

In considering the value of these two standards, one must regard each in its relation to the five principal applications of gas, viz.: (1) Open-flame lighting, (2) mantle lighting, (3) domestic cooking, water heating and room heating, (4) industrial heating, and (5) power production.

Obviously the open-flame candle power of a gas is the direct measure of its usefulness for open-flame lighting. Since there is no fixed relation between heating value and the open-flame candle

power of a gas, the heating value offers no guide in judging its usefulness in open flames.

For mantle lighting it is generally believed that the usefulness is nearly proportional to the heating value of the gas. Although this is not exact, as between open-flame candle power and heating value of a gas, the latter is much better as a criterion of the usefulness for mantle illumination. One of the best illustrations of this is in an article by R. ff. Pierce (AMERICAN GAS LIGHT JOURNAL, 103, 1-5, 1915), in which a number of tests are reported. They show no relation between the mantle candle power and the open-flame candle power, but a general relation of mantle candle power to heating value of the gas, between 540 and 640 B. T. U. Taking the average of all tests, one finds a surprising uniformity of mantle candle power per heat unit supplied per hour; the average varying less than 3% over the interval 540 to 640 B. T. U. This range of 100 B. T. U. covers almost all conditions met in ordinary gas supply practice in the United States.

In domestic water heating, room heating, and cooking appliances the value of the gas should be proportional to the heat available from its combustion; however, with too rich a gas the efficiency of utilization is less than with one of lower heating value. It is not, therefore, exactly correct to say that the usefulness is in proportion to the heating value; but the ratio between the two is so nearly constant that it may be regarded as uniform for ordinary ranges of gas quality.

In the industrial applications of gas for heating, the control of the gas supply is much more exact than in domestic use, and it will usually be found that the heating value is an almost exact measure of the usefulness of the gas.

For power production there are many factors important in determining the value of the gas; the open-flame candle power certainly is not of significance, but the heating value is of considerable importance. The latter property may be regarded as a satisfactory criterion by which to judge a varying supply, but it is not sufficient for comparing two different kinds of gas, *e. g.*, a carbureted water-gas and run-of-oven by-product gas.

Summarizing the matter, it appears that heating value is a direct measure of the usefulness for industrial heating, and for domestic water heating, room heating, and cooking; that it is not an exact measure of the value for mantle lighting and for power production, but is more significant than candle-power; and that the open-flame candle power is a significant property for open-flame lighting only. However, it should not be overlooked that a gas of good open-flame candle power necessarily has a good heating value, and thus maintenance of a candle power standard offers large measure of protection as to the heating value of the gas. It is largely because of this that candle power standards have so long remained in force.

History of Regulations.—The changes in requirements, as well as in methods of enforcement, have been very rapid in the past few years. For example, only 5 years ago there was but one state with a law prescribing a heating value of gas; at the present time there are thirteen regulations of this nature in force over whole states, and four sets of rules pending, in which similar requirements are included. As the number of state public utility commissions is increasing each year, it is not unlikely that within 5 years more there will be some requirement as to heating value of gas in the majority of the states.

The candle power requirements have in most cases been superseded by heating-value standards, but there still remain candle power regulations in Massachusetts (16 candles) and New York (16, 18, and 20 candles, according to the kind of gas made); and there are also old regulations in Ohio and New Jersey, the status of which is not clear, fixing minimum candle power values of 12 and 14 candles respectively. There are also forty or more cities in which candle power requirements are still in force. In some the candle power requirement supplements a heating-value standard; in others, candle power is the only quality prescribed.

The Relative Advantages of the Two Standards.—It is generally accepted that heating value is a better measure of the general usefulness of the gas. It is also important to bear in mind the advantage to the gas maker of the heating standard, because of the greater ease of regular operation to meet a heat unit standard, and the smaller percentage loss in B. T. U. during distribution. Tests of heating value can be made with greater accuracy than candle power tests. The uncertainties accompanying enforcement of such rules are therefore a minimum; due to the accuracy of testing possible, and to the exactness of the definition of heating value. This property of the gas is a specific one, determined only by the character of the gas; and not like candle power, primarily dependent upon the character and condition of the burner used, atmospheric conditions, and other factors, many of which cannot be controlled or corrected for.

Assuming that a heating value standard is the proper one, it is necessary to give attention to two general cases: Where the heating value standard is to supersede a candle-power requirement; and when a heating-value standard is adopted where no rules have been in force. The latter of these conditions will be considered first as the one more easily settled.

The Proper Basis for Heating-Value Standards.

The problem of selecting a proper standard for heating-value is primarily an economic one. It is usually a question of determining the value that will permit observance of the fundamental demands listed above, especially the fifth, viz.: "Maximum service for each unit of cost to the user."

The Problem of Relative Costs.—In its simplest form, the selection of a standard would be where it is only necessary to determine for each of several qualities of gas the proper average price to the customer, and then to select that quality that permits delivery of the most heat for each dollar. For example, we can assume a certain quality of gas and certain values for each of the principal items that go to make up the total charge to the customer, and from these compute the number of heat units he would receive for a dollar. Then applying the same calculations to other quality of gas, the relative value is clear.

If full data were available for any given city, and there were no complicating conditions to influence the decision, it would be fairly easy to adjust the standard to local conditions. However, there are many factors of importance, and it is to their consideration the greatest attention must be given. The following sections cover briefly some of the most important of these factors

Character of Fuels Available.—The character of fuels available in any locality is a very important factor in determining the quality of gas that can properly be required. In some districts, there are grades of gas coal that permit manufacture of gas of 600 or more B. T. U. per cubic foot with yields of more than 5 cubic feet per pound of coal, and produce excellent coke; and the requirement of 600 B. T. U. monthly average would generally place no unreasonable limitations on the manufacturer. But it is often found that to make gas of 600 B. T. U. regularly, would require the purchase of unusually expensive coals, or reduction of the gas yield to uneconomical figure, or would destroy the value of the coke (it being still high in volatile matter); or in extreme cases lead to the abandonment of coal gas manufacture.

The choice of methods of manufacture and sources of fuel are, therefore, often determined by the standard fixed for quality. This is proper only if it is the one likely to ensure to the consumer the most service for each dollar of cost. For example, to fix a standard that would prevent the manufacture of coal gas would be very undesirable, unless it was evident that coal gas was very uneconomical for that locality. Similarly a requirement in the mid-western States that could be met only by purchase of West Virginia or Washington coals, might be highly undesirable; since it would perhaps be possible to supply more heat for a dollar in a lower quality of gas made from coal from nearby fields.

In many cases cutting down the yield per pound of coal is sufficient to give gas of a high quality. Some engineers urge that it is never justifiable to require so high a value as to make this necessary. Complete gasification of a coal is often very desirable in order to produce a coke very low in volatile matter; when considering such cases, however, the relative net holder cost per heat unit is not the only factor to be taken into account. Let us assume data for an illustration of this point, as follows:

Assumed for Three Conditions of Operation.

	Case 1.	Case 2.	Case 3.
Yield (cubic feet per pound).....	5.50	5.00	4.50
Gas quality (B. T. U. per cubic foot)..	570	600	630
Net holder cost (cents per 1,000 cubic feet).....	27.75	30.00	32.25
Interest, taxes, depreciation and return on investment (cents per 1,000)....	26.0	24.0	23.0

This gives for the three cases 3,135, 3,000 and 2,835 B. T. U. in the gas per pound of coal carbonized. With increase in yield, the "net holder cost" per 1,000 cubic feet, of course, decreases, as it covers expense of manufacture less return from residuals. The "*interest, taxes, depreciation, and return on investment in manufacturing plant (cost per 1,000 cubic feet)*" would, of course, be directly proportional to the investment for each 1,000 cubic feet per day average output, assuming that the same percentage of

value is allowed for these items, regardless of the quality of the gas made. Of course, the investment per 1,000 capacity varies with coking time (among other things); and since the higher yield would require longer coking time, the item increases per 1,000 cubic feet when the yield is increased.

Computing from these hypothetical data we would find:

	Case 1.	Case 2.	Case 3.
Net holder cost (cents per 1,000,000 B. T. U.)	48.7	50.0	51.2
Interest, taxes, depreciation and return on investment in manufacturing plant (cents per 1,000,000 B. T. U.)	45.6	40.0	36.5
Total cost per 1,000,000 B. T. U. put in holder (cents)	94.3	90.0	87.7

If the data applied to any city, it would be proper to conclude that the largest yield would not be the more economical, since the *total* manufacturing cost would be greater for each million heat units put in the holder, despite the fact that the net holder cost per million heat units would be less for the gas giving highest yields.

The above data are admittedly assumed in relations to illustrate the point emphasized; and though they may not be typical for gas of 570 to 630 B. T. U., yet they are fairly representative of conditions found in some places. In any event they serve to illustrate one method of comparison.

It is reasonable to assume that conservation of the fuel supplies seldom demands a sacrifice of the most economical conditions of operation for the present, in order to secure the possible future advantages by retaining better fuels unused. Although economy for a year or two, at the expense of the following years, is not unusually justifiable, an attempt to estimate for very long periods introduces so many uncertainties that too great emphasis may at times be placed on our duty to posterity.

Summarizing these points in reference to the fuel supply one finds that the standard should conform to the following conditions:

1. Not be so severe as to prevent choice of the most economical processes of gas making.
2. Permit use of the most economical fuel available on the local market.
3. Be sure to allow reasonable yields of gas per pound of coal, and permit manufacture of a quality of coke suited to the local market.

Kind and Condition of Plant and Machinery in Use.—If a standard is to be fixed for a locality where there is no gas plant, there would be no need to consider the type of plant, except from the standpoint of minimum total cost of production. However, in a majority of places, the standards adopted affect the operation of a plant already in use, and it is necessary to have it so adjusted that it will not necessitate the abandonment of the plant. The limitations of existing plants should not, however, be allowed to prevent changes to standards that would really be more economical, all things considered. Conditions permitting the greatest economy over considerable periods are, of course, the most desirable. In computing relative costs for operating expenses, taxes, interest, depreciation and return on the investment should be combined, with proper allowance for retirement of abandoned equipment, to make the comparison on the basis of true total costs. The depreciation condition of a plant will in some cases influence gas quality requirements, but will seldom be an important factor, except for short periods.

To fully appreciate the problem for any particular process one must be on the lookout for special manufacturing limitations. For example, in operating certain styles of "straight-shot" oil gas machines, the character of the tar and lampblack separated from the gas is largely affected by the quality of the gas made. In some instances, it is claimed that the production of richer gas than is now made would result in a smaller yield of valuable by-product, and would give a mixture of tar and lampblack exceedingly difficult to handle. Similarly the natural limitations of a by-product gas oven are important in the consideration of the problem.

The local conditions in a city often introduce peculiar demands in the way of flexibility of operating to meet larger or frequent changes in gas sales. Under such conditions water gas is often a necessity, despite its greater cost, and the irregularities in character of gas by the changes in load, become a factor influencing the choice of standards. It is often argued that such conditions demand that the standard be fixed for the worst condition likely to result, but is not at all necessary, for a good average can be maintained and certain tolerance fixed for the unusual cases.

Local By-Product Markets.—Where especially favorable markets for coke, tar, benzol, or other by-products are found, the advantages in low net holder cost with one style plant and system of operation, are often sufficient to offset disadvantages in lower standard or large plant investment. In such cases the simplest form of cost comparison, like the illustrations already given, reveals the most economical conditions of operation. Similarly the demand for a coke very low in volatile matter often places a premium on operation with high yields of gas, and makes lower standards of gas quality advantageous even to the gas customers, assuming, of course, that the customers share in the advantages by receiving gas at the proper price for the lower quality.

Demand for benzol has, in some instances, introduced entirely new factors into cost comparisons. The recovery of benzol by washing the gas with oil results in a large lowering of the open flame candle power, which can, when necessary, be corrected by enrichment with carbureted water gas, or other high-candled product; or the low candle power gas may be supplied without enrichment. The decrease in the heating value of the gas from washing is appreciable; but usually there is a much lower percentage decrease in heating value than in candle power. The application of the process is, therefore, often not interfered with by a heating value requirement; but if the process decreases the usefulness of the gas for open-flame lighting, a share of the profits of the process should go to users, in the form of a lower rate for gas.

Distribution Losses.—Gas, when subjected to low temperature, high pressure, or "friction," loses certain constituents contributing to its heating and lighting value. It is, of course, necessary to take account of these distribution losses in fixing standards for gas; but it has been found that the loss in heating value is much smaller in percentage than the loss in candle power that occurs simultaneously.

In one series of tests reported to the Bureau, it was found that pumping a by-product gas that had been "benzolized" up to about 16 candles and 600 B. T. U. total heating value, produced losses of about 40% in candle power, and less than 7% in heating value, due to transmission at 30 pounds pressure for 9 miles with the ground temperature below 50 F. Obviously such treatment of a benzolized gas is very severe and the losses approximate the maximum to be expected. Another series of tests on similar gas mixed with carbureted water gas showed losses of 35% in candle power and only 4 to 5% in heating value. In another investigation a 22-candle, 620 B. T. U. carbureted water gas was pumped at 16 pounds pressure, with loss of candle power equivalent to 15 and 30% at 2 and 5-mile points with simultaneous average loss of only 1.57 and 1.75% respectively in heating value. These last results are believed to be more nearly typical for conditions ordinarily found in the United States.

In the Northern states it is sometimes necessary to allow somewhat lower values in the winter than would otherwise be necessary; but if monthly heating value be the primary basis for gas quality standard, the losses during cold weather would rarely make the average for a full month fall much below what would have resulted in warmer weather. A deficiency of 5 or 10 (or in extreme cases 25) B. T. U. due solely to unusual weather, could properly be allowed to pass as an unpreventable deficiency not subjecting the company to penalty or criticism.

The tests mentioned above show that on a typical gas, even of high candle power, the loss in heating value is so small that any water gas, mixed gas, or coal gas of 600 B. T. U. can be regarded as "stable" in heating value under all ordinary conditions. Therefore, with any standard not much in excess of 600 monthly average, the distribution losses are not likely to seriously affect the choice of a standard.

The value to the user of uniformity in supply is sufficient in some cases to recommend one standard as preferable to another; but the uniformity possible is rarely enough greater in any case for any value up to 630 B. T. U. to be a deciding factor. When the candle power standard in force would ensure an average of say 600 B. T. U, but would tend to give higher than the average during the summer, some disadvantage to the customer may result, as compared with a fairly uniform production of 590 to 610 B. T. U. monthly average. This is one of the inherent disadvantages of the candle power standard.

The tests of gas quality should be made at points that ensure results representative of the gas actually delivered to users. Tests at the works are of value, but do not detect loss in heating value during supply because of improper "condensing" of the gas. If

tests at the works are used as the principal basis of control, it is desirable that they be supplemented by tests at some distance from the works from time to time, in order to determine that the gas does not deterioiate unduly enroute to the users. It appears desirable that the standard of quality be based on the heating value of the gas, determined at any point within a mile of the manufacturing plant, or within a mile of the center of distribution if the supply is not manufactured within the city where it is utilized. Of course, it is not desirable to require such a high quality of gas in suburban localities, that it is necessary to materially increase the average quality of all gas made at a central plant in a big city. However, it is much better to establish a standard for the quality as delivered to the user, and then for suburban districts, or for cities supplied from plants at considerable distance from the center of distribution, allow a tolerance below the general average, corresponding to the necessary decrease by delivery to the distant points.

In some state regulations, allowance is made for losses during compression and pumping of gas at high pressure. It is doubtful, however, whether there is any need for as large tolerance in this particular as is sometimes made. It would rarely be necessary to allow more than 25 B. T. U. for compression and pumping of gas under ordinary conditions. The instances cited in previous paragraphs, and the examples given in the report of the Joint Calorimeter Committee of the Second District of New York, illustrate this fact. To fix a requirement that would prevent high pressure distributions is very undesirable; but the tolerance allowed in heating value should not be so great as to permit gas of unnecessarily low quality being supplied at the distant points. If the gas before compression is well condensed and meets the general heating value standards, reasonable allowance for necessary losses during compression should be made.

Significance of Total Gas Sales.—A large part of the total cost of gas to the user is made up of charges that are more or less constant per year. In computing costs per 1,000 cubic feet, or costs per 1,000,000 B.T.U., it is of importance to know the total sales.

If the quality of the gas supplied in any city is materially changed it is evident that the quantity sold may also change. In some cases the change in quality would be accompanied by a proportionate change in quantity required; or, in other words, the total amount of heat required by the customer is constant, and, therefore, independent of the quality of the gas. Under other circumstances, the volume of gas used will be particularly constant, regardless of the quality; this in the case of appliances that are turned on for fixed periods and which would not require (or would not receive) adjustment for the new quality of gas. In some cases the volume of gas utilized would be independent of the quality; in others, the total heat utilized would be constant; and in practice it is probable that some intermediate condition would represent the average.

Very little data is available to show what changes in sales have actually accompanied changes in quality. However, the Bureau has secured some data from one city, covering the period immediately preceding and following a change from oil gas of about 630 B. T. U. to a mixture of oil gas and natural gas of much higher heating value. They show very little change in the total quantity of heat required by gas consumers. However, they are not applicable to all cities, since the fuel supply conditions were materially different from those of the rest of the country. Practically all of the gas was used in such a way that the customer was interested only in the heat obtained, and a change in quality would not alter the total heat required. It was noted that during the early part of the period of comparison, the increase in sales corresponded fairly well with the increase in number of meters. Subsequently, when the increase in the heating value had been made, the decrease in sales per meter about corresponded to the increase in heating value, showing that the total heat per meter per month was practically constant.

In many cases the effect of changing the price of gas has been studied to determine what change in sales usually accompany it. Almost invariably, when the price of gas is reduced the income in dollars per year per meter does not greatly change; in other words, there is a tendency for each consumer to pay about the same gas bill regardless of the price per 1,000 cubic feet. This is due to several causes, among the most important of which are the increasing field opened to gas at a lower price, and the natural tendency of the customer to consider his gas bill excessive, and therefore to begin to practice economy only when the bill exceeds the amount he is accustomed to pay.

Although a change in quality of gas is not exactly analogous to a change in price, nevertheless, the greater number of factors that influence sales in the one case, correspondingly influence the other. In other words, it should be anticipated that for a change in quality of gas the price per 1,000 cubic feet being constant, the change in sales would be less proportionately than the change in quality. In other words, we have the natural tendency of the customer to utilize a fixed quantity of gas. If an increase in heating value is not accompanied by a proportionate decrease in the quantity required, it tends to make the cost per heat unit to the customer less with the richer gas, because some items of expense are constant for any period, independent of sales. However, no great weight should be given to this factor in determining which condition is the more desirable from the standpoint of the customer. For practical purposes it is best to assume that the total heat that will be used for a fixed service is about the same, regardless of the heating value per cubic foot.

In any case where the cost per heat unit changes with change in quality, a new factor enters; the increased field in which gas can be applied when the cost per heat unit is less. In such cases, of course, the estimates of changes in sales must not be made wholly on the heat units previously used per year; the estimated increase in consumers should be considered.

These factors may be summarized as follows:

1. For most computations, it is safe to assume that the total heat required per year for present users of gas will be little changed by a change in price of gas.

2. Many users of small quantities of gas tend to use gas to about a fixed cost per month regardless of the quality of price

3. Although in the industrial use of gas there is a tendency toward a constant number of heat units employed each year regardless of quality, decreases in cost make possible new applications for gas and thus largely affect sales.

Special Systems of Rates for Gas.—There are two methods for charging for gas, other than the flat rate per thousand cubic feet, that are of interest in considering standards for quality. One system, is that whereby the charge is based solely upon the heat furnished; that is, the charge would be per million B. T. U. and not per 1,000 cubic feet of gas. Obviously there is no need to specify the quality supplied under this system, except to ensure that it will be reasonably useful and uniform. This system of charging has one great advantage, in that it allows changes in methods of manufacture and in fuel used, to a condition that permit the most economical operation. In this respect it is in line with the idea emphasized earlier in this paper, that the results should be specified and the means of their accomplishment left to the manufacturers.

The other system of charging is that general group of schedules in which there is fixed for each customer, a so-called consumer's charge and a demand charge, which are made to cover expense items dependent upon the number of customers or the customers' "demand," but independent of the quantity of gas used. In some schedules these two charges are combined in a single charge per customer, graduated according to his "demand." There is, of course, a charge for gas itself, according to the quantity used; but this is only part of the bill, and for any small customer only a small part. With this system any change in quality, as for example, 10% decrease in heating value, even though accompanied by a corresponding change in consumption (10% increase in volume used) does not have as large a percentage influence upon the customer's bill. Engineers have argued from this, that it is not as important to control accurately the quality of the gas as would otherwise be necessary. However, this conclusion is not justified. The average number of heat units that can be delivered to the customer for each dollar is the best measure of efficiency of the sys-system. It is, therefore, necessary to control the heat delivered to the customer under such a system of rates, as accurately as under any other system. Otherwise the cost to the small user and to the large user will not be properly distributed; and some customers will suffer unless the rate is fixed to correspond, for each class of customers, to the actual cost for the quality supplied. In order to determine whether or not one quality is better than another, the total cost per million heat units should be used, and it is not necessary to analyze the cost into several groups. To analyze the cost into consumers costs, demand costs and output costs, as has been done by some State commissions, does, however, give a valuable guide in determining the variation of certain items of cost, with such variation in sales as accompany changes in quality of gas. But such analysis is not fundamental to the final comparisons.

Uniformity of Gas Quality Required.—Obviously it is important that gas appliances give satisfactory operation at all times, with

no great amount of attention on the part of the customer, since the majority of users can not be expected to adjust their appliances to meet new conditions of gas supply. To a greater or less extent, industrial users make such adjustments, but the domestic utilization of gas is ordinarily dependent upon such uniformity of supply as will permit satisfactory operation without requiring adjustment of appliances.

Both for safety and for efficiency of use, it is essential that the appliances operate at all times with complete combustion of the gas (except appliances having flue combustion, in which slightly incomplete combustion could be tolerated). It is very undesirable to have changes in gas supply that will produce sooting of the appliance, or of the vessels heated, or of the mantle; and it is dangerous to have such variation as might produce carbon monoxide by incomplete combustion.

There are four factors that largely affect the safety, efficiency, cleanliness, and convenience of a gas consuming appliance. They are: (1) The heating value per cubic foot; (2) the volume of air required for combustion of a cubic foot of gas; (3) the pressure of gas supply, and (4) the density of the gas. The pressure can be regulated independently of the other three, but these are largely interdependent, and it is doubtful whether it is practicable to undertake to control all three properties at the same time.

It is evident, other things being equal, that the higher the heating value the more heat there will be supplied at a burner per unit of time; and usually an increase in heating value will be accompanied by an increase in the quanity of air required for complete combustion. Increasing the pressure, and decreasing the size of openihg through which the gas enters the mixing chamber will increase the injector action and, therefore, facilitate the mixing of air and gas. Change in density of the gas usually accompanies change in heating value, and largely affect the rate of flow of gas through the orifice into the mixing chamber, under given pressure.

It is only possible to control all these factors by very elaborate precaution. However, the general effect of each is known; and changes which would be detrimental can in some cases be cared for by changes in the other conditions of supply.

It is, of course, necessary in changing from one condition of supply to another, to bring about the change with such precautions that the customers will have opportunity to adjust their conditions of use to the new conditions of supply.

Relation of New Standards to Former Standards and Quality.

Changes in Heating Value.—In adopting a heating value standard, whether it supersedes a candle power standard or not, it is important to know what the quality of gas has been in the past. In the majority of cases the quality of gas supplied will be known to have been more or less satisfactory to the users, and the cost of production will be known; but in order to make an intelligent comparison data should be available as to the heating value of the supply in the past.

It is not possible to judge the heating value of a gas if only the candle power is known; the only satisfactory method for determining heating value is the regular use of a calorimeter. The installation and regular operation of a calorimeter in any plant making 10,000,000 or 15,000,000 cubic feet of gas or more per year is a good investment. Indeed, it has been said by one of our best known gas engineers that no company making 10,000,000 cubic feet of gas per year can afford to be without one. The investment of the $250 to $300 necessary, allowing 20% interest and depreciation per year, is well worth while, measured by the saving in operating costs; and it appears to the writer that even if the manager of the works must himself make the tests, the time would be well spent.

Although it is impossible to say for every case, it seems generally that new standards have permitted decrease in the heating value furnished. The Joint Committee on Calorimetry of the Second District of New York reports on investigations extendeding over 15 months, and the operation of sixteen companies making various kinds of gas. The minimum average heating value over the entire period for any company was 606 B. T. U. and twelve companies gave an average over 620 B. T. U. The committee recommended for New York State a standard of 570 B. T. U. monthly average total heating value, measured at the manufacturing plant. It did not draw any comparison between the quality of the gas supplied in the past and the quality which it proposes as a standard, nor indicate what advantage, if any, the customers would secure in return for the concession in quality recommended. The average for all sixteen companies investigated was 627 B. T. U. or exactly 10% above the standard proposed. If this standard were adopted and the companies supplied only the quality required, it is evident that the customers would secure very much less heat than formerly. Furthermore, there is nothing in the report to suggest that the change in quality should be accompanied by any change in price to the public.

With regular calorimetric tests to guide in works operation, it is generally possible to maintain, without increase in costs of manufacture, an average heating value at least as high as the average carried during operating on a candle power basis. For example, manufacture of 600 B. T. U. gas throughout the year would probably be less expensive than making gas of a candle power that would average 600 B. T. U. Therefore, when a commission adopts a heating value standard that does not require a richer gas than supplied under the old candle power requirement, the operating costs would seldom, be increased by the change; in many cases the cost per 1,000 cubic feet would be decreased. It is generally proper that when a heating value standard is adopted it should require gas of at least as good quality as was formerly furnished, unless there be some concession in price, or need of increase in the return of the company. Two state commissions have attempted to accomplish this by requiring that companies now supplying a heating value above the standard adopted, must not reduce the quality without permission and without considering the reasonableness of changing the price to correspond with the new quality. In adopting 565 B. T. U. for Illinois, that Commission made such requirement, and the Public Service Commission of Connecticut has fixed a similar regulation in connection with a standard of B. T. U.

Unless it is established more clearly than it appears that, a heating value materially below 600 has an economic advantage, there is no need of changing present general practice. It would seem rational in fixing a standard for a whole State to establish a requirement approximately equal to the quality of gas supplied in a majority of the plants operating and giving good service. Then if it is found that some plants are unable to maintain this average, it is quite proper to afford relief by permitting them to supply a lower quality than fixed by the general requirement, at a special price for that quality. It is not proper to assume that the standard must be fixed so that the poorest plant will at times of greatest difficulty be able to meet the standard. To be really a standard for service in the proper sense, the requirements should be such as will ensure gas of good quality from all companies, with tolerance properly arranged to permit necessary variations, either for single months, for single days, or for companies that operate under peculiar conditions.

Influence of Candle Power Standards.—Although a candle power requirement is no longer the best for quality of gas, nevertheless good candle power ensures good quality to the user whether it be used for lighting, heating, or other purpose. Indeed it is impossible to produce high candle power without making gas of high heating value.

When a heating value standard has been determined, the value of a supplemental candle power standard is an important question. The following paragraphs from the third edition of circular No. 32 cover this subject:

"The time has not yet come in all places, when customers requiring open flame candle power in gas are negligible numerically; nor has it yet been proved that the manufacture of a non-luminous gas is most economical or desirable. It may be desired, therefore, to retain in city ordinances a minimum candle power requirement as a secondary standard; such minimum should always be so low that the manufacture of gas is not complicated nor its cost increased. It is not essential that the State rules include such candle power provision, since the State commission can from time to time amend its rules.

"A minimum candle power requirement, together with the heating value specification is not what is usually understood by a 'double standard.' The latter involves a candle power requirement as difficult to meet as the heating value requirement, so that the gas maker must watch and control both calorimetric and photometric values. This is not recommended. It is again emphasized that the candle power should be made the secondary specification under ordinary conditions, and be so low that it will not embarrass the manufacturer. A nominal candle power gas will be sufficient for use in the few places where an open flame burner is preferable to a mantle light, and the gas made by the ordinary processes of

(*Continued on page 106.*)

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CHARLES H. WADELTON,
Secretary and Manager.

NEW YORK, MONDAY, FEBRUARY 14, 1916.

Proposes 550 B. T. U. Minimum for Massachusetts.

The Massachusetts Gas and Electric Light Commission has recommended a bill to the Legislature, which would empower that board from time to time to determine how many British thermal units shall be required of gas supplied by companies and municipal plants to their customers; in no event to be less than 550 B. T. U. Thereafter, if the company, town or city shall be found on three consecutive inspections, or within 30 days, to be supplying gas below the established colorific standard, unless such defect is unavoidabe, a fine of $100 may be imposed.

The bill provides that in connection with inquiries made by the Board under the above provision, it may suspend the operation of law as to candle power of gas for periods not exceeding 9 months. It also provides that every company or municipal plant distributing over 15,000,000 cubic feet a year shall, when required by the Board, provide and maintain a suitable room, not less than one-quarter of a mile from the gas works, with a calorimeter of approved type, for the use of the State inspectors.

N. C. G. A. Board of Directors Meeting.

The January meeting of the officers and directors of the National Commercial Gas Association was held at the headquarters of the Association, 61 Broadway, New York, on Friday, the 21st. There were present:

Jansen Haines, President,	H. B. McLean,
Louis Stotz, Secretary,	Arthur Hewitt,
J. B. Myers,	W. W. Barnes,
S. T. Willson,	Oscar H. Fogg,
B. J. Kellum,	C. A. Monroe,
C. B. Stull,	H. S. Schutt,
T. M. Ambler,	R. R. Young.

The Board accepted the resignations of C. L. Holman and C. B. Babcock, and elected as directors for two years, in their place, J. J. Burns, of St. Louis, Mo., and C. E. Bartlett, of Philadelphia, Pa.

A finance committee, consisting of W. H. Pettes, Chairman; C. W. Hare, O. F. Potter, George H. Scranton and J. P. Zingg, was elected for the year 1916.

The Secretary submitted for approval, a budget, an estimate of receipts and expenditures for the entire year. It was decided that this budget should be followed as closely as possible, and no expenditures other than those estimated for, be made during the year, unless for specific purposes, and only on approval of the Board.

The Board approved the following schedule of prices for the various sections of the Salesman's Handbook:

Gas manufacture and distribution	$0.25
Illumination	0.25
Domestic cooking appliances	0.25
Water heating	0.25
Miscellaneous domestic appliances	0.25
Heating	0.25
General tables, units and technical terms	0.25
Buyers' index	2.00
Gas engines and power	2.00
Industrial fuel appliances	2.00

The Board approved the retaining of Dr. Lee Galloway as Director of the Educational Courses for 1916; and the employment of Miss T. M. Will as educational assistant, and to be a permanent member of the Association's Headquarters Staff.

Approval was given to the following recommendation of the Board of Educational control:

That the Educational Course be divided into three periods—the first period covering the material in the preparatory division; the second period covering the material in the first ten lessons of the special courses; the third period to cover the balance of the lessons in the special courses. Also, that in future no enrollments to the courses be accepted except on the basis of tuition paid in advance for the entire course, or payable in advance for each of the three periods into which the course is divided.

It was decided that the work of the Central Development Bureau, in collaboration with the special committee of the American Gas Institute be continued, and a new Chairman appointed in place of Mr. R. C. Ware, who is about to go abroad.

A suggestion having been made that the Association publish a Bulletin of Abstracts of Commercial Data and Information, the matter was referred to J. B. Myers, to get data as to the cost of supplying such a service, and report to the Board at its next meeting.

The Board approved the recommendation of the Manufacturers' Section that future exhibits of the Association be conducted along the lines of the Washington exhibit, it having been found that the exclusion of the general public was desirable, and enabled the exhibitor and visiting gas men to do business without interference and on a more satisfactory basis.

The Secretary was instructed to communicate with all the state and district gas associations, asking them to present to their members, for approval, the following resolution which was presented and approved by the N. C. G. A. at the Washington convention.

Resolved "That in view of the almost universal adoption of the incandescent mantle system of illumination, in which field the heating value of gas approaches most closely the measure of its commercial worth; and

"In view of the great and increasing demand for gas for industrial and domestic purposes other than illumination, in which field its commercial worth is solely proportional to its heating value; and

"It being a matter of record that the leading authorities, after making exhaustive and impartial examinations, have concluded that the heating value is the proper basis of rating of gas quality, which conclusion is emphasized by recent State Commission Rules having specified that the rating of gas quality shall be based on the heating value of the gas;

"We, the National Commercial Gas Association, would and do hereby earnestly recommend the adoption of the heating value basis in rating the value of gas."

The Secretary was instructed to communicate with the American Gas Institute requesting it to appoint a committee to co-operate with the Central Development Bureau, and to offer the Bureau of Census assistance in the preparation and compilation of up-to-date, authoritative and comprehensive statistics covering the gas industry.

The Board approved the copy prepared by a special committee for insertion in Sweet's Catalog of Building Materials.

The Secretary was instructed to communicate with the various state and district gas associations, asking the privileges of the floor at their annual meeting for a delegate of the N. C. G. A. for the purpose of calling attention to the work the Association is doing, and looking toward a closer co-operation between the N. C. G. A. and the various gas associations.

The Board decided that the National Gas Range Week, this year, be the second week in May, from the 8th to the 13th.

Messrs Oscar H. Fogg and W. W. Barnes were appointed a Committee to co-operate with the Bureau of Standards in the preparation of a National Gas Safety Code.

Mr. McBride's Paper to the Gas Congress.

This paper, which we print somewhat condensed, was probably the most important presented to the Congress, as showing the attitude of the Bureau of Standards toward the heating value standard for gas, and their reasoning in reaching those conclusions. Mr. McBride brings together most of the questions to be considered, and treats them with a fair mind.

Southern Association Papers.

The papers announced for the meeting of the Southern Gas Association, at Tampa, Fla., April 19th, 20th and 21st, are as follows:

"The Small Gas Consumer," by S. P. Vecker, Key West, Fla.
Written discussions by F. L. Marshall, of Augusta, Ga., and C. M. Osbourne, of Talledega.

"Gas Company Accounting," by H. O. Hanson, Chicago, Ills.
Written discussions by John W. Golden, of Savannah, Ga., and C. M. Benedict, of Charleston, S. C.

"Industrial Fuel Business," by S. Tully Willson, Brooklyn, N. Y.
Written discussions by Carl Case, of Cleveland, O., and S. E. De Freese, of Chattanooga, Tenn.

"Gratuitous Work," by B. F. Nobler, Montgomery, Ala.
Written discussions by M. T. Walker, of Beaumont, Tex., and E. M. Osbourne, of Talledega, Ala.

"Rust Deposits in Mains and Services," by A. F. Kersting, Mobile, Ala.
Written Discussions by R. L. Ellis, of Selma, Ala., and J. E. Montgomery, of Birmingham, Ala.

"Inclined Chamber Retorts," by H. G. Veasey, Jacksonville, Fla.
Written discussions by Carl Wyckoff, of Mobile, Ala., and R. J. Titzel, of New Orleans, La.

"Hydraulic Control of Steam Valves," by E. E. Bair, Hanover, Pa.
Written discussion by C. F. Zeek, of Pensacola, Fla.

[OFFICIAL NOTICE.]

New England Association of Gas Engineers.

The 46th Annual Meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, Wednesday and Thursday, February 16th and 17th, 1915.

The following papers are being prepared:

"Gas Meters," by Chas. D. Jenkins, Boston.

"High Pressure Systems and Welding of High Pressure Mains at Springfield, Mass.," by A. S. Hall, Springfield.

"Intensified Selling, as Applied to Gas Water Heaters," by A. A. Higgins, Providence, R. I.

"Aligning and Releveling 200,000 cubic foot Holder at New London," by V. E. Bird, New London, Conn.

"Burning and Distilling Water Gas Tar," by Chas. Otten, Jr., Haverhill, Mass.

"Residence Burner Maintenance," by W. A. Parkhurst, Lowell, Mass.

The Question Box includes the following:

"What Carbonization Results are being Obtained in New England?"

"Is it Profitable for a Gas Company to have a Separate Store for the Sale and Exhibition of Appliances?"

"Is Income per Meter Greater from Prepay or Regular Meters among Poorer Consumers?"

"How can Income from Coal Tar Products be Increased?"

Valuable answers to this last question will be given.

Application for membership should be sent to the Secretary before February 15th.

The Annual Dinner will be at Young's Hotel, on the evening of Wednesday, at 6:30 o'clock.

On Thursday, February 17th, at 3 P.M., at the City Club, Mr. W. D. A. Ryan will give his magnificent illustrated lecture on "Illumination at the Panama Pacific Exposition." This will be a rare treat.

Please plan to be prompt in attending the sessions.

N. W. GIFFORD, Secretary.

Illinois Gas Association.

OFFICE OF THE SECRETARY,
OAK PARK. ILLS.

The Twelfth Annual Meeting of the Illinois Gas Association will be held in Chicago, March 22d and 23d, 1916. This will be the most instructive and interesting program ever had by a State Gas Association.

The papers will be divided into four classes: General, Manufacturing, Distribution and Commercial. Not all of the papers have been decided upon as yet, but the following are assured:

"Stores Accounting," by W. A. Sauer.

"Constructive Advertising," by J. W. Lansley.

"Functions of Trade Journals," by Milt Saul.

"Gratuitous Work," by A. L. Tossell.

"The Proper Use of Gas in the Home," by W. H. Forbes.

"Some Fundamentals Affecting the Utilization of Gas Oil in Carburetted Water Gas Manufacture," by R. C. Downing.

"Treating Waste Water in Gas Plants," by Paul Hansen.

"Tools, their Use and Maintenance," by P. M. Slocum.

"A Report of the Committee on Meter Shelves," by E. H. Negley.

"Some Investigations of Bunsen Gas Burner Design and Operation," by G. C. Carnahan.

We expect to have a paper on a recent coal gas installation, similar to last year's paper on the Decatur plant, also a paper on New Business, and others. We will have reports from the various committees—Public Relations, Rates, Affiliation, Gas Engineering, etc. The Entertainment Committee, as usual, will have something extra fine at the banquet.

In connection with the circular letter sent out August 20th, we wish to correct, as far as possible, the inference that many gained, that we were interested in one particular Journal. Neither the Illinois Gas Association, nor its officers, wish to influence any of the members to become subscribers to any one particular journal, as they all deserve your encouragement and support. In the early days of the Association the Gas Journals contributed in many ways to help the struggling societies, and they now deserve your earnest support. We desire to call the attention of the members to the number of valuable articles published in the trade journals and periodicals, and urge the members to become subscribers to, and read as many as possible.

It has been proposed that the Illinois Electric Association, the Illinois Electric Street Railways Association and the Illinois Gas Association, consolidate into one Utility Association, or hold a joint meeting. We would be pleased to receive suggestions from members on this subject. HORACE H. CLARK, Secretary

(Continued from page 103.)

The Substitution of Heating Value for Candle Power as a Standard for Gas Quality.

the present day will be satisfactory in quality even if only heating value is controlled, since the lowest open flame candle power would seldom be less than 12 candles, if the gas were 600 B. T. U. or higher."

Adjustment of Conditions to Suit New Standards.—When a change in standard makes considerable change in candle power, heating value or other property of the gas, it may be essential that certain types of appliances be readjusted to suit the new quality. And if a gas very low in open-flame candle power is substituted for one of high candle power, it may be necessary to consider means for eliminating open-flame lighting; or so adjust conditions that no material loss will be forced on users of open-flames. It is usually not necessary for the regulating official to specify the methods to be employed in accomplishing such ends. The results to be secured, however, can very properly be indicated in a general way and designated as one of the conditions under which changes in the standard will be allowed.

In this connection the very important influence of public opinion may be suggested. If changes apparently detrimental to the quality of service are made, the loss to the company because of unfavorable public opionion is often serious. The public is often prejudiced because of incomplete understanding of the facts; it is important, therefore, that a full, frank statement of the facts be made, in order to make clear to customers the mutual advantage expected from the readjustment of conditions.

Inter-Relation of Rates and Standards.—Obviously, the proper standard for gas quality is closely related to the rates charged. In considering any particular heating value it is necessary to consider relative costs and relative rates to the public.

With the adoption of a new standard for service it is sometimes found that new rates are desirable. For example, the Minneapolis Gas Light Company in requesting a change from a 22-candle requirement to 600 B. T. U. suggested its willingness to make certain concessions in price. Accordingly an adjustment was made between the city officials and the gas company, fixing standards for the quality of gas service and the rate for gas, and conditions for readjustment of rates from time to time. Several other instances are similar to this. Only recently the Public Service Commission of Maryland, offered a choice to the Baltimore Consolidated Gas, Electric Light and Power Company between two conditions as follows: (1) The supply of gas of 20-candles and 645 B. T. U. total heating value; and (2) gas of 600 B. T. U. monthly average at 5 cents lower than the old price.

If it is certain that the new standard ensures service as good as previously rendered, the customer is assured of at least as satisfactory conditions as formerly existed. If it is evident that the rate in force is too low to ensure proper return to the company, it is proper to consider whether or not it is better to lower the quality of the gas, or whether it is economically better to increase the price charged for it.

The Bureau has not investigated absolute costs for gas, except as has been necessary in considering the related problems of standards and costs. t has, however, frequently been necessary to consider relative costs. In this consideration a striking condition has been observed, namely, that the estimates, submitted to the Bureau, of increase in cost accompanying increase in heating value, almost invariably largely exceed the estimates of saving from a reduction in heating value from the higher to the lower value compared. Obviously, changes in cost and quality upward are exactly equal to the changes of cost and quality downward over the same range *under similar conditions.* Of course, this reversibility of estimates may not hold when change in type of plant, radical changes in operating methods, or different sources of fuels are made necessary by the difference in standards.

It is admitted by most engineers that the conditions under which maximum quantity of heat can be delivered for a dollar, are the best for the gas company as well as for the user of gas. However, the delay in adjustment of price to correspond properly with the heating value often brings about a conditon that one or the other party has a temporary advantage because of changes in standards. In many localities there is a tendency to consider the standard for service entirely secondary to the question of rates. This is largely due, it appears, to the popular interests in rates, and the lack of popular interest in quality of service. As a matter of fact the rate and the standard are interdependent and co-ordinate in importance.

English High Pressure Mains.

From a paper by B. F. Botwood, to the Midland Junior Gas Association.

It is not within the scope of a paper such as this to discuss the question of high pressure gas supply at length. Therefore, I intend to touch upon one or two details of the laying and fitting-up of wrought iron mains in Birmingham during the last two or three years.

The first main I shall describe is an 8" and 6" main running through Icknield and Pitsford streets and Western road, laid to give an industrial supply to two factories. It consisted of 320 yards of 8" and 952 yards of 6" wrought iron pipe, the laying of which occupied 27 working days, or an average of 47.1 yards per diem, including fitting up of valves, syphons, expansion joints, etc. The tube used was steam strength, wrapped with brattice cloth and coated with composition. The sockets were of Stewart & Lloyd's tapered screw pattern. After the joints were tested, the sockets were wrapped with brattle cloth and coated with bitumen.

The 6" cast iron syphons (drips) used were not fitted with loose covers, as in the larger sizes, but cast in one piece, the top of the casting having a boss or center piece to allow the attachment of a hydrant valve for clearing the condensation. All valves are of the worm-and-rack type, double flanged and faced. The ends of the valve spindles are provided with a cast steel false top, secured to the spindle proper by a set screw. The size of square on these attachments is standard, and allows of one key suiting any size of valve. This is an advantage, inasmuch as a variation in the size of spindle squares leads to confusion. Further, all valves for high pressure are so made that when the spindle is rotated "with the clock," the valve is closed.

The expansion joints are of cast iron, shown in Fig. 1, fitted to a syphon. The joint consists of three pieces, *A*, *B* and *C*; the portion *A* allows for a $\frac{3}{8}$" lead joint round the wrought iron pipe, and *B* for a graphite packing and the gland *C*. Any escape of gas in the joint passes into the annular space round the pipe in the portion *B*, and thence through the outlet boss to a rotary meter, the outlet of which is connected with a 1" tube to the nearest low pressure main.

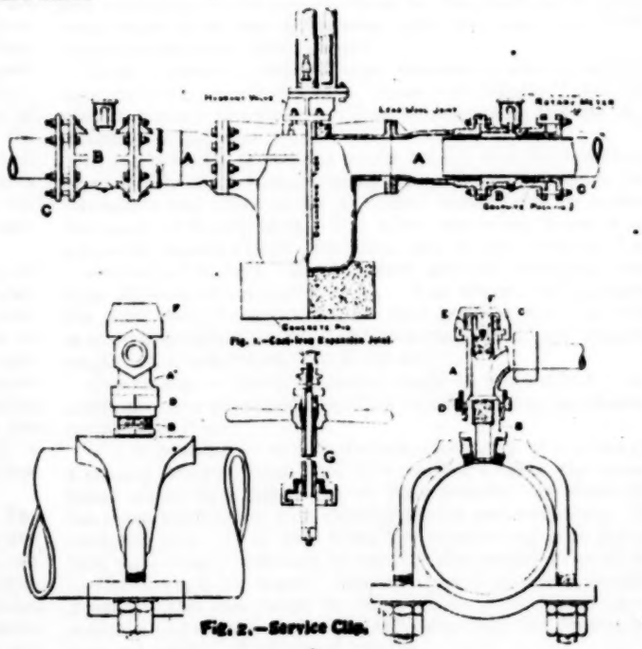


Fig. 2.—Service Clip.

The joint between the flanges is made with a Taylor joint ring of corrugated copper, well "buttered" with jointing paste. Grease packing is not used in the gland joint, as the action of the gas causes it to deteriorate, while graphite will remain sound for a long period. This also applies—and perhaps more especially—to the gland packing in valves for high pressure in contact with a gas more or less dehydrated. All expansion joints are boxed round with an annular wooden box to free them from the weight of superimposed earth, and to render periodical inspection easy.

The rotary meters are covered with an ordinary lock box, and are read for leakage from time to time.

Service Attachment.—After one or two experimental models had been made and tested, a service clip was designed which has proved efficient, both as regards ease of attachment and cheapness. The clip (Fig 2) is a retangular boss, having wings on either side, the lower extremity threaded, to allow for bolting to the under plate. The underside of the retangular boss is machined to a radius of $\frac{1}{16}$" larger than that of the main, to allow for a joint, which is made with sheet lead, bedded in mangesite jointing paste. The clips are drop-stamped hot from strip iron, of a tensile strength 26 to 32 tons per square inch; and, after screwing and machining, are bent to template. The radial face and top face are not bored and pined, but milled with a radius and circular cutter respectively, which insures a surface free from tool marks. This is an important point, as it is essential that there should be an absolutely "fair" surface to avoid leakage. The under plate of the clip is an ordinary forging.

The under-pressure ferrule tap (also shown on Fig. 2), consists of a cast steel body, *A*, a steel main plug, *B*, a removal gun metal plug, *C*, a gun metal union, *D*, a backnut *E*, and a cap, *F*. The plug, *C*, has square and tapped holes provided, for engaging the operating tool *G*.

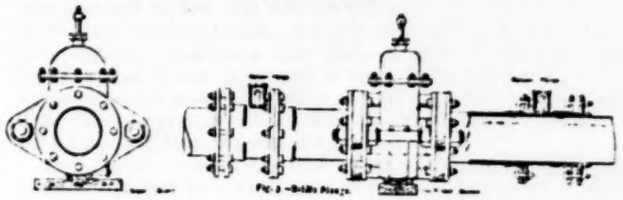
When running a service, the procedure is briefly as follows:—The main is stripped of its covering and well cleaned and the clip bolted on. The underside of the drilling-tackle bed has a rectangular rubber pad to make a gas-tight joint with the machine top face of the clip. The drill-spindle works through a gland; and the base of the drill-gland is provided with a gate-valve. The drills are of the cup variety, tap combined. When the clip and main have been drilled, the drill-spindle is run back until it is clear of the gate-valve, which is then closed. The top of the machine is swung over, the drill removed, and the ferrule tap plug B, with C, inserted with a yarn grummet well smeared with graphite paste on the underside of the hexagon. The valve is then opened, the plug screwed home into the main, and the drilling tackle removed. The body A and union D are then attached, and the service run from the outlet of the body. When ready for the testing the tool G is locked on the top of the body A, with a bayonet catch. The centre spindle enters the square hole in the plug C, which is then screwed back into the top of the body, A as shown in Fig. 2. The backnut E and cap F are fixed; the latter filled with tallow; and, lastly, the wrapping and coating of the main and ferrule tap are completed, and all joints tested. Before filling the trench, the service is troughed and tarred. Each service has a double-faced worm-and-rack valve just inside the curb, with a long screw on the building side to facilitate disconnecting, should the need arise.

Another Main-laying Operation.—The next is a 9" wrought iron main with Stewarts and Lloyds long-sleeve oxy-acetylene welded joints, laid for the purpose of reinforcing a district in the south-west of the area of supply. It supplies gas at high pressure to a governor-house at Harts Green, Harborne, where it is "broken down" to district pressure. This point is about $6\frac{1}{2}$ miles from Windsor Street Gas Works and about $3\frac{1}{2}$ miles from the nearest high pressure main—viz., the 12" main laid during 1910-11 for the purpose of reinforcing King's Norton district. The governors at Harborne are 495' above sea level, while those at Windsor Street works, whence the district received the greater portion of its low pressure supply, are 358' above.

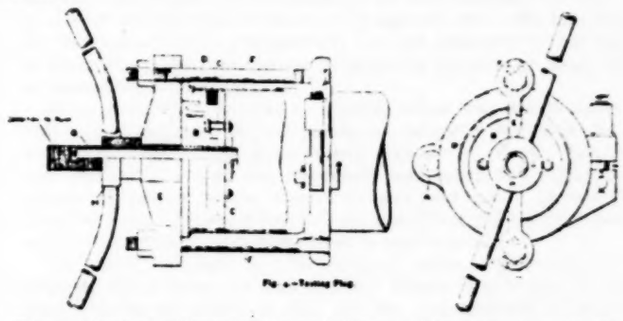
The laying of this main occupied three gangs, commenced October 20, 1913, and completed on February 4, 1914—thus giving a daily laying of 20.28 yards per gang. The daily figure is in reality much greater, but is reduced on the whole period by unavoidable delays. The main was, where possible, laid under the footpath, with a cover of of 2' 6"; the pipe wrapped, excepting a portion at the spigot end and the sockets, with brattice cloth and coated with composition.

The main is divided into five nearly equal sections by double-faced worm-and-rack valves. The syphons used were cast iron and double flanged, fitted with a hydrant valve for pumping. It has been proved that the expansion or contraction of a wrought iron or steel main is sufficient to seriously interfere with the working of a cast iron valve, and in extreme cases to even fracture the body of the valve.

Although Birmingham has been free from such mishaps, it was thought desirable to safeguard the valves and syphons by "bridling" them. The bridle flange (shown on valve in fig. 3) consists of a gland-shaped wrought-iron forging 2" thick, the centre bored out to the internal diameter of the main, and drilled the same as the flange it is to bed against. The two extreme ends are drilled for 2" bolts, the area of metal in the cross section of the two bolts should at least be equal to the area of the metal in a section of the main. These bridal flanges are set between the flanges of the expansion joint and the valve or syphon; the joints being made with corrugated copper gaskets. Should there be sufficient friction in the expansion joints to prevent their action, the bridles will receive the trust or pull. Care should be taken when tightening-up the nut on the 2" tension bolts that no "pinch" is transferred to the valve or syphon flanges.



Mode of Testing.—This main was tested with 30 pounds air pressure; the testing plug designed being shown in Fig. 4. It consists of a clip *A*, with trunnions forged on its circumference, an angle ring and back-plate *B*, a rubber joint-ring *C*, a compression collar *D*, a cross-bar *E*, tension bolts *F*, a tension tube *G* (which is also used for connecting to the compressor) and a wing-nut *H*.



The method of adjustment is as follows: The clips *A* are bolted round the main back of the socket. The angle ring and back-plate *B* and compression collar *D*, with the rubber joint-ring *C* interposed, is placed in the socket; and the cross-bar *E* is adjusted, by the tension bolts, to bed against the compression ring. The wing-nut *G* is then screwed home, drawing the angle ring and back-plate towards the front of the socket, squeezing the rubber ring and forming a joint round the inside of the socket. The main is then pumped up to test pressure through tube *G*. The total pressure on the face of a plug for a 9" internal bore main at 30 pounds per square inch is approximately $18\frac{1}{2}$ cwt.; and during one test it held pressure without the slightest loss for 65 minutes. The average time occupied in fixing the plug and connecting to the compressor is about 40 seconds.

The portable compressor used was of a double-acting type, direct couple to a 15 horse power gasoline motor.

On February 4, the whole length of main, from Pershore Road to the governor-house in Vicarage Road, Harbone, was placed under test. For this purpose, the compressor was stationed in the latter and connected to the rising-pipe of a syphon. Pumping was commenced at 12.45 P.M., and ceased at 5.22 P.M., when the gauge showed point 32.5 pounds per square inch. The total length under test was 16,109 feet.

The governors used in the Harborne governor-house are of the Reynold-Donkin type, having an effective radius of $1\frac{1}{2}$ miles.

Welded Joints. The welded joints in the line have, so far, proved satisfactory; but I would point out one of two things. Care should be taken that the metal in the joint is not subjected to too much heat in fluxing; otherwise pin-holes will form, which, though easily calked, are a source of annoyance and loss of time. The ends of the main should be left open to allow for expansion of the contained air during welding. If this is neglected, the same trouble as with overheating will result. If it is necessary to "cant" a pipe, the "cant" should be given in the joint. The practice of making a straight joint and then springing the pipe over in the trench, is bad, and it throws an undue strain on the jointing metal, which might under additional shock, prove fatal to the soundness of the joint. The wire used for jointing was Swedish iron, about $\frac{1}{8}$" diameter.

Testing a High Pressure Joint.—I will describe a test made at Nechells Gas Works; the joint being a 4" spigot and facet joint, made by the British Mannesmann Tube Company. The joint was of lead wool backed with yarn. The effective length of the tube was about 14 feet; the joint being 6 feet from an end. After

jointing at the Landore Works of the Mannesmann Company, a permanent set had been given to the tube of 1 foot $11\frac{1}{4}$ inches; the pressure being applied just in front of the socket. On testing the joint at Nechells, it was found leaking. The lead had not been effectively caulked, so the joint was remade, though no more wool was used; and the following test was carried out. The tube was supported at two points 10′ $7\frac{3}{4}$″ apart; the joint being 4′ $2\frac{1}{2}$″ from a support. A load of 21 cwt. was slung from the tube; the slings being $15\frac{1}{2}$″ on either side of the original point where force had been applied. The load gave a deflection of $1\frac{1}{8}$″, and while in this condition the joint was tested and found sound under air pressure of forty pounds. The tube was unloaded and laid on the ground, and force applied with a jack to the point 10′ in front of the socket, in order to draw the joint; and a deflection of $1\frac{1}{2}$″ was obtained; but the set was not permanent, the tube recovering its original position. The packings against which the tube bedded during the test, were 3′ $3\frac{1}{2}$″ apart. These were moved to 10′ 6″, and a permanent set of $5\frac{3}{4}$″ in addition to the original one of 1′ $11\frac{1}{4}$″ was given to the tube with the jack. The joint still remained sound, and was then again loaded with 21 cwt., and repeatedly struck with a hammer, while under pressure of 40 pounds, but maintained its soundness. It has been found necessary to alter portions of the 12″ reinforcing main to Kings Norton and section of about 383 yards will be laid with Mannesmann tube having these joints, while other sections will have Stewart and Lloyd's long sleeve welded joint.

Waste in Public Utility Power Plants.

From paper by FRANCIS W. COLLINS, in "Engineering Magazine."

This article is based on the examination of public utility properties for bankers and industrial plants for owners; and many of the examinations did not involve actual physical tests—not because they were not desired, but because it was impracticable to make them, and other criteria usually gave results sufficiently close to answer the purposes in hand. The properties were mostly in towns of 2,500 to 30,000 or 40,000 inhabitants—a few with 100,000 to 300,000 population. There has been no opportunity to observe the progress made by these plants after the first examination, consequently I will set forth what I encountered and point out the bearing of these facts upon the interests of the owners of the properties. In short, what is offered is a plea for better plant design, better equipment and better operation, rather than a statement of how the results are to be obtained. To go into both ends of the matter would be impossible in the space available, nor will an attempt be made to show how the conditions arose. No doubt there are enough excuses for them, but there can be no valid excuse for repeating blunders, nor for allowing remediable conditions to persist in the face of betterments possible at justifiable cost.

The Lack of Records.—In no case have I found an inventory of the plant even approximately complete, to say nothing of being correct as far as it went. If there were any records at all they covered only portions of the property, and were deficient in one or more of the following respects: They lacked dates, lacked proper description, were not up-to-date, abandoned plants were not shown on records, and other information was missing. The accounting records were often of indifferent value, but generally they are worth more than any others, from an historical standpoint. It is astonishing how much information is left out of estimates, plans, specifications, etc.

As a general thing, there are few records worth considering. The only thing to fall back on being "memory." The only person who knows anything about the equipment, its age, whether bought new or second hand, inspections, etc., is one of the older plant employees—perhaps an engineer, a fireman, or a foreman—and his memory may not always be reliable. The managers or owners know less and their memories are less to be trusted. Managers are very apt to have been connected with the property only a few years, and the owners view such matters as of trivial importance.

One would think that with thousands of dollars worth (often running into the hundreds) of property involved, that the simple records required would be inaugurated and kept up to date. The trouble probably lies largely in the customary practice of measuring everything by dollars of immediate net profit — let to-morrow take care of itself — and the fear of running into endless records kept up only at burdensome expense.

But with public service regulation accepted, with industrial regulation looming up on the horizon, and with governmental activities and restrictions of all kinds coming to be the fashion, it behooves every owner to seriously consider the question of really knowing about his property, instead of thinking or guessing. There is no excuse for a man, if he wishes to be thought honest, to say a boiler has a capacity of 150 horsepower when it is only of 100 or 125. Nor for his understating or overstating the amount of copper wire by a good many pounds — as frequently under as overstated.

Ignorance of Performance.—It is one thing to know what a machine will do, quite another to keep a finger on what it is doing. The attitude seems to be, "keep the wheels turning." How they turn is insignificant. Leaky water lines (even when buying water by meter), leaky steam lines, incompetent boiler attendance, shafts out of line, belts improperly adjusted, and journals needing attention, are a few of the things that cut down performance. They are usually viewed with indifference, or those in charge are largely ignorant of them.

I have found very few plant engineers using engine indicators. With few exceptions the plant engineer does not know whether the valves of his engines and pumps are properly set. It is an out and out guess. Piston and valve leakage, worn out or improper pump packing, and all the ills machinery can be heir to are the common rather than the exceptional things.

In nine cases out of ten all these continue because of ignorance as to actual performance. In a large percentage of cases those in charge know that some particular thing is not as it should be, but they do not know how much "out of kelter" nor what the result, directly or indirectly, is in dollars and cents. It is most unusual to find any man who traces performances back to the coal pile and store room.

Proper tests or inspections at regular or irregular intervals are seldom or never undertaken; it is only when something breaks or goes so wrong that repairs have to be made.

Ignorant of Output.—The output of a plant is seldom known with anything approaching an accuracy. Generally, considering all the obstacles, gas plants knows reasonably well their output, yet it is not rare to find smaller ones without station meters. Electric plants generally make some attempt to meter machine or station output; few do so completely, and it is unusually impossible to determine the output with any degree of satisfaction. Both reading and recording meters are too cheap for the question of installation costs stand in the way of knowing what the output is. Very few water plants meter their output.

When it comes to learning what demands a plant is being called upon to meet, one encounters a "stone-wall defense." And furthermore there is a complete dearth of knowledge as to what the plant should be called upon to do.

In the majority of cases it would appear that the location of the plant at a particular spot was an after-thought; a whim or some immediate real estate profit or other selfish motive, rather than the result of forethought. Too often the power house is without adequate transportation facilities and is far removed from the "centroid of its load," which means greater operating cost, perhaps ultimate investment cost too. The design and equipment of the plant are not quite so indifferently handled, but the difference is more apparent than real. All this runs right back into knowing what "local conditions" must be met.

Competition.—There is another angle to this subject, i. e., competition. Any plant not operating as efficiently as possible is competing with itself.

If it is practicable to manufacture electricity in a given case for 4 cents a kilowatt-hour, and it is costing 5 cents, the owners are losing money they might put in their pockets. In short, there is too much satisfaction with existing profits and conditions. We are naturally lazy. It is only when the margin begins to get narrow that there is an awakening to the fact that money is being allowed to slip through the fingers, then ensues a scramble to recover lost ground. This can never be done. Like time, money cannot be snatched out of the realms of the past—only the present and future are sources of unearned returns.

Competition, which includes increasing costs of labor and materials, is likely to be more severely felt in the future than in the past. The public utility is asking to be protected from competitors in its territory, and in return for this it owes a duty to the public—of giving maximum service for minimum charges. The public is not slow to go after what it considers its rights.

The industrial owner has no such protection, and now it is not recognized that he owes such a duty. However, there are exactions in other forms no less burdensome, and in the long run just as sure to lead to trouble. His taxes are going up—they are likely to go up by leaps and bounds, due to the era of sentimental gov-

ernment meddling with all things under the sun. His labor cost and material cost are giving him plenty to worry about.

Then comes in the fact that anyone at all, without capital and almost without credit—the only requisite is nerve—can start up a manufacturing establishment in his own field. This upstart can play havoc unending with the legitimate manufacturer; he owes no responsibility, moral or mental. We are competition mad.

The Human Element.—After all that can be thought of or said about studying, planning, designing or building, and all phases of operation, there remains one feature little understood. I refer to the "man element." In many respects better men are required to operate a small plant than a large one. I have seen a plant give passably good results solely because the engineer in charge was the one real asset—the plant itself was a liability. The plant force takes its cue from its superiors; that is, the men know the manager, or owner, a whole lot better than he knows them. They know what they have to do, what they can do, what they may do. The manager, unknowingly, conveys his ideas, whims, and fancies to those under him. His shortcomings are better known to them than to himself.

My experience leaves me in no doubt that on the management rests the responsibility for power house leaks, if for no other reason than that just given. That the plant is not run in the most economical manner is principally because—

(a) The management does not get out of the employees what they can and would give.

(b) The employees are not always wisely selected. Their hiring is too often a matter of how little they will work for, rather than how well will they perform their duties.

(c) There is need for raising the plane of the employee. He should have fixed in his mind more of an ideal. The management must not permit him to drift along on a basis of "will it do," or "will the old man kick." Too frequently I hear, "It is good enough," or "It is the best we can do."

So many times I find that an employe makes a suggestion only to have it fall flat, and after a few such experiences he keeps his ideas to himself. The least the management can do, if the suggestion can be used, is to show by word and action a proper appreciation, or, if the suggestion cannot be used, to turn it aside in a way that will leave the door open, so the employe will feel invited to make other suggestions. No fancy methods or schemes need be adopted to accomplish this; just old fashioned horse sense, fair dealing, frankness, sincerity and tact will accomplish the purpose, and a good deal more.

Then, the management must back up the suggestions. Suppose an engine really needs repairing. Nothing is cheaper in the long run than to have it done well and promptly. Aside from being better for the engine it is better for the plant, and has a great moral effect on the employees. Pursuing such a policy will do more to bring a run down plant into better operating condition than any one thing. It will keep a new plant in shape far longer than otherwise could be done.

Fixing the Responsibility.—A part of the responsibility rests upon manufacturers. Machinery is too often sold without really knowing whether it will give satisfaction or not. Like the owner, the manufacturer knows too little about local conditions. This is less true to-day of the best manufacturers than formerly, and they have assumed more responsibility of finding out what the local service conditions are, and have gone about it in a broader minded way.

In reality power plant leaks are very largely due to ignorance on the part of the management. After learning how the Bell Telephone Companies go at these matters the contrast will be striking. Weeks or months are spent in what they call a "fundamental plant study"—studying existing conditions and what has taken place in years past. From these studies and upon them, plans are made for development for years to come. Pole lines are laid out, wires and cables strung, exchanges built, land bought for the future; all in accordance with predetermined plans. In other words, the Bell people make a study of past, present, and future demands of the public.

To the utility or industrial plant owner this is revolutionary, and, at first glance, seems out of the question. I contend that it is far from impracticable, although contrary to usual practice. To-day, even small plants devote time and energy to canvassing their communities for new consumers. The expense of studying a whole town to find the requirements of past and present, as well as possible new consumers, and finding out who cannot possibly become consumers, will come within the appropriations most companies make for getting new business—canvassing, selling appliances, etc. Too little study has been given this by most utility managers. Some of the larger companies have undertaken well considered fundamental plan studies, but the usual efforts consist in merely a house to house canvas, which is far short of what should be done.

I have seen a 250-horse power engine driving a 500-kilowatt generator, and, in another case, a 100-horse power engine driving a 50-kilowatt generator. Such conditions are extremes, but it is very common to find one not far removed. A familiar type is the small plant burdened with a turbine installation, suitable only for very different conditions than likely to exist in that community. The situation in any given case is more often than not a plant designed with too scant knowledge of local conditions—past, present and future—equipped with a hodge-podge of machinery, operated on a basis of "keep it going, boys!"

Regulation.—I will grant that in many cases the most economical operation cannot be worked out now because the cost of remedying past indiscretions would be too burdensome. But herein is the nub of every such a situation—whether utility or industrial plant; These conditions should be amortized so far as it is possible, and the hole worked out of. The courts and public service commissions both say so.

An ill-designed or ill-equipped plant, or one inefficiently operated, is no defense for unreasonable rates. The policy of regulatory bodies is to compel the amortization of depreciation, whether due to life, or obsolesence, or errors of judgment, etc.—the past cannot be resurrected and so charged off, *i. e.*, the tendency is that failure to amortize in the past cannot be made up for now or later, so far as operating expenses go.

So here is what we find: Plants, unless they are to suffer on rates charged, must be well designed, properly equipped and efficiently operated. The government says so in effect. How then can any owner, or any one financially interested, fail to appreciate where the things herein suggested will land him? In this direction public service commissions have unwittingly done more to promote the efficiency movement than is appreciated.

The industrial plant may be the next victim of government regulation, if the signs are read aright. There is, perhaps, an opportunity in the intermediate lull, for the management to profit by what is taking place. The larger plants can afford, if they are alive to the demands of the occasion, to spend the money necessary to study their problems. That they do not, is due to the present satisfaction with results. But it is with the smaller plants that perhaps the situation is more serious, relatively. In this direction the various associations and technical societies have accomplished much. Still something is lacking with them as with larger plants; it is the realization that leaks are seriously sapping the properties in many directions.

One of these directions is in securing capital for improvements and additions. A partial solution has been the absorption of many properties by holding companies, which thus permit of more advantageous financing. The holding company era seems to be on the wane, perhaps due as much to unduly heavy overhead costs in many instances, as anything else. There are many plants outside the probability of consolidation with others. These then must work out their problems single-handed.

One should not gain the impression that because the holding groups have advantages from a financing viewpoint, their problems are any different or relatively nearer solution. I have found operating conditions not greatly better in a number of such instances, due to failure to appreciate just such things as here suggested.

Accidents that Could have been Prevented.

A piece of hot coke dropped into a stoker's shoe, and burned his foot.

Shoes with loose fitting tops should be avoided in such work.

A carpenter's helper after using a chisel, laid it down beside him. Later he stepped on the chisel, which rolled under his foot and caused him to fall from a building. Careful, methodical habits would eliminate many an accident of this kind.

While drawing sludge acid from an agitator, the acid splashed from the receiving pan into a workman's eye. This man wears goggles now and advises that others do so in similar work.

A watchman was filling s lantern with oil while it was still burning; the oil ignited and his face was burned. This case certainly exhibits a reckless indifference to one's safety.

An engineer jumped from a ladder when one of the rails broke, and his back was iniured. Ladders are a frequent source of injury and should be closely inspected. "Safety News."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

IT has been decided to hold the annual meeting of the Iowa District Gas Association at Dubuque, Ia., in conjunction with the I. E. A. and the I. S. and U. R. R. A. The dates for the meeting were originally set for May 17th, 18th and 19th. At a meeting of a joint committee of the three associations, in Davenport, it was decided to change the date to May 10th, 11th and 12th, because the N. E. L. A. is to hold its annual meeting in the latter part of May.

THE controlling interest in the Imperial Valley Gas Company, El Centro, Cal., has been acquired by Mr. J. M. Ott, of Rochester, Ind., who becomes president and general manager of the company.

THE Davis-Bournonville Company has an exhibit and demonstration of oxy-acetylene welding and cutting apparatus at the Panama Pacific Medal Winners Exposition, in the Grand Central Palace, New York city, from February 12 to 22.

R. C. WARE, assistant to Mr. E. N. Wrighington, secretary and commercial manager of the Boston Consolidated Gas Company, sailed on a French steamship on February 2nd to join the French Hospital Corps.

THE Niagara Light, Heat & Power Company, a Doherty property, has been interesting manufacturers of Tonawanda and North Tonawanda, N. Y., by allowing one of its windows to be used without charge by the leading interests in that city, allotting one week to each manufacturer. This made it possible for some manufacturers to make displays that would otherwise have been impossible, and the competition for the use of the window was keen.

THE Kennebec Gas & Fuel Company, Waterville, Me., has appointed W. H. Fritchman its engineer, and elected him a member of the board of directors.

MR. EMERSON MCMILLIN, Chairman of the Board of the American Light and Traction Co., has founded two scholarships in the Engineering School of the Detroit University of Detroit, Mich. Mr. McMillin's interest in the University was developed from the fact his organizations employ many mechanical, civil and electrical engineers, and he is interested in enlarging the opportunities for young men to follow these pursuits.

ALTHOUGH most of the large hotels and restaurants in New York and Chicago are pretty well converted to the practicability of gas ranges, there is still strong objection on the part of many chefs: and in Denver, Col., a campaign by the New Business Department of the Denver Gas nnd Electric Light Company has just converted the chefs of a leading hotel, the Childs' restaurants, the Union Station and a large department store, among others, but still finds some opposition. To put it in the words of a member of the department, they are "making a strong effort to get closer to the chef."

AT the last convention of the Southern Gas Association, a committee was appointed to ascertain and report at the next meeting just what is being done in maintenance of gas lighting in the South, particularly residence lighting. In compiling this report the committee has received answers to questions from 65 companies. This information will be treated confidentially, no names of companies to be shown in the report.

THE Russell Engineering Company announces that Mr. C. H. Fritch has joined their sales force. Mr. Fritch has had 15 years experience in gas bench construction and is well known to the industry.

THE Gulf States Steel Company, Birmingham, Ala., announces the signing of a contract with the H. Koppers Company to build 37 Koppers by-product coke ovens at Alabama City. The work is to be finished by January, 1917.. The output will supply the Gulf States Steel Company's blast furnace and the surplus gas will be used in the steel works adjoining.

MR. F. R. HUTCHINSON has resigned as special agent of the East Ohio Gas Company, Cleveland, O., and is now sales manager for the Automatic Draft Regulator Co. This company makes a device to be attached to the flue pipes of gas appliances to prevent down drafts or excessive drafts, and to help ventilate the room in which the appliance is used.

THE People's Gas Light & Coke Company of Chicago has been formally ordered by the State Public Utilities Commission to begin at once the taking of an inventory and the making of an appraisal of its property, and to submit it to the commission within four months. The figures are wanted for the purpose of fixing a gas rate.

JOHN HILDEBRANDT is manager of the South Haven (Mich.) Gas Company, succeeding L. C. Ryall, who has resigned to go on the road selling bonds of the gas companies in which the Messrs. Runyan and their associates are interested. Stewart Swift succeeds Mr. Hildebrandt as cashier and bookkeeper.

W. H. MOWRER, President of the Bloomfield (Neb.) Gas and Electric Co., has sold the gas plant to a new company, and the new owners have taken charge. F. L. Bates, of Memphis, the president of the new company, will oversee the remodeling work, which will take until the middle of next month.

ACCEPTING the invitation of the Knoxville (Tenn.) Gas Company, members of the city commission will go on an investigating trip to Washington and other cities in the east and north, to study street lighting by gas. The invitation was accepted on the motion of Commissioner John W. Flenniken, who stated that he was heartily in favor of going into the street lighting question thoroughly, with a view to deciding which illuminant will be most satisfactory for Knoxville.

ON protests from Baltimore consumers concerning the new 35-cent rate for excess consumption, the Consolidated Gas, Electric Light and Power Company has filed an amended schedule with the Public Service Commission, which that body has authorized to go into effect at once. Under the new plan the rating for gas is on a per room basis. For instance, for a 6-room house the average consumption is placed at 4,000 cubic feet per month, and the customer will be charged 75 cents per 1,000 up to that quantity, and in excess of that volume, only 35 cents per 1,000. Each additional room in a house will be rated on a 1,000-foot basis as the average consumption. The company has also filed a new schedule, revising the plan for 35-cent gas for industrial concerns. For such places the initial rate is 60 cents net up to 2,000 cubic feet, and 35 cents for all excess gas used up to 1,000,000 cubic feet.

COL. E. G. PRATT represented the Dayton (Ohio) Gas Company in the valuation made of that company's property in its controversy with the city.

THE Gratiot County Gas Company, Alma, Mich., has announced a change from water to coal gas, to be made as soon as the plant can be installed. Work has already been started. The company is now supplying four Gratiot towns with gas, Ithaca, St. Louis, Breckenridge and Alma.

THE officers for the ensuing year of the Lawrence (Mass.) Gas Company Employees' Association were elected at their last meeting A smoke talk and card tournament followed the election. A pleasing entertainment program was enjoyed and refreshments were served by the club's stewards, John McLeod and John Creeley. President Daniel J. DeCourcy occupied the chair at the business session when reports of the secretary and treasurer were read, showing the association on a good financial footing. The following officers were elected: President, Daniel J. DeCourcy; vice-president, Joseph Sharkey; secretary, Herbert Petzold; treasurer, Fred Harmon; executive committee, George Hoffman, Arthur Griffiths, Timothy Kane, Cornelius Creeley, Thomas Garner, Clarence Osgood, William McQuestion, John Creeley, Cornelius A. McCarthy and John Morrissey.

THE Southern Gas and Improvement Company, Elizabeth City, N. C., according to J. T. Stallings, manager, expects to begin work within the next week on extensive improvements, including a new main from the plant at the foot of Road street to Church street.

THE New Haven, Conn., "Chronicle" says: "The beautiful assembly room of the New Haven Gas Light Co., with seats for more than 100 people, and with its raised platform and dainty all-white model kitchen, is placed at the service of women's organizations for morning or afternoon meetings, free of any charge whatever. The room is lighted with artistic semi-indirect gas lighting bowls and side bracket lights, so that, if the ladies' meetings are prolonged to an afternoon hour when artificial light is needed. Even the illumination is furnished without charge. The room is now used by the house economic department of the New Haven Woman's Club, the Sunshine Society, and the educational classes of the gas company.

R. L. SPIERING, until recently Superintendent of the gas plant of the Public Service Company of St. Cloud, Minn., resigned a short time ago to accept the superintendency of the Crookston Gas Company.

THE Old Colony Gas Company, Braintree, Mass., has installed a 12 horse-power gas steam boiler in one of the buildings at the Hingham Naval Magazine, where it will heat tanks to clean the brass shells that have been used in target practice before they are reloaded. Gas will also be used for annealing the shells before reshaping and for many other purposes.

THE reduction in the price of gas to 80 cents a thousand in Richmond, Va., now becomes effective. The city fathers expect that the reduction will result in a larger consumption of gas and that the net profit to the city will be thereby increased. The profit from the sale of gas last year was $55,211 more than in the preceding year. Council accepted the ordinance offered by Alderman Powers, lowering the price to consumers, after a fight of several months.

NEGOTIATIONS are underway between the Continental Motor Manufacturing Company and the Muskegon (Mich.) Traction and Lighting Company for furnishing 5,000,000 cubic feet of gas per month for use in their shops. Should the contract go through, the gas company will be obliged to work night and day, winter and summer. At present the company has to work only during the day in the summer months.

ALBAN H. SOMMAR, for the last 5 years chief clerk in the offices of the Savannah (Ga.) Gas Company, has resigned to accept the position of chief clerk with the Omaha (Neb.) Gas Company. Mr. Sommar will be succeeded by W. H. Bischoff, who has been connected with the Savannah Gas Company for several years. The promotion of Mr. Bischoff will bring about other office changes.

AT the annual meeting of stockholders of the Detroit (Mich.) City Gas Company, directors were re-elected as follows: Emerson McMillin, Alanson P. Lathrop, New York; Victor F. Dewey, George E. Lawson, Frank P. Byrne, Alonzo P. Ewing, Homer Warren and Henry E. Bodman, Detroit. Officers re-elected are: President, Emerson McMillin; vice-president and general manager, Victor F. Dewey; vice-president, Alanson P. Lathrop; secretary and treasurer, Charles S. Ritter; auditor, Henry W. Sherriffs; assistant treasurer, John M. Wright; assistant secretary, C. N. Jelliffe, New York; assistant auditor, James Lawrence; consulting engineer, H. C. Abell.

AT the annual meeting of the Winsted (Conn.) Gas Company, the following directors were elected; Harvey L. Roberts, Marvin H. Tanner, Edward R. Holmes, Henry Skinner, J. M. Travis, Irving R. Griswold, Lorenzo M. Blake and Frank M. Travis. Officers elected were: President and general manager, Colonel Henry Skinner; secretary, Frank M. Travis; treasurer, J. M. Travis.

PRESENT plans of the gas department of the Rochester (N. Y.) Railway and Light Company are to lay 15 miles of new gas mains in 1916. This is in addition to the proposed extensions to Pittsford and East Rochester, which will have gas service furnished them before the end of the season.

UTILITIES COMMISSION NEWS.

LIGHTING COMPANY'S NOT OBLIGATED TO INSPECT CUSTOMER'S APPLIANCES.—In a case against the Northumberland County Gas & Electric Company before the Supreme Court of Pennsylvania for damages arising from a fire caused by a short circuit where the service wires passed through the outer wall of a building, it was held that a lighting company is not bound to inspect appliances owned and maintained by the customer, nor is it liable for damages from defect therein.

BOARD RULES PROFITS ARE NOT TOO HIGH.—Finding that the New Jersey Gas Company receives less than 6½% return on the present value of its property, the State Board of Public Utility Commissioners has dismissed the complaints of ten municipalities in southern New Jersey, alleging that the rates charged by the company are unreasonable.

Tracing the history of the organization, which was formed by the consolidation of a number of companies, the board's report shows a total outstanding capital stock of $1,975,425. This, the board said, was in excess of the present value of the property, which was placed at $1,141,619. The cost of reproduction was estimated by the board's engineers at $1,258,213 or $717,207 less than the capitalization.

The company claimed that to the valuation of its physical property, as determined by the engineers, there should be added $458,176 for intangibles. This claim was not allowed, but the board allowed $115,392 for development costs, and legal services in fixing the rate making base. The total operating revenue of the company for 1914 was $189,210, and net operating revenues, excluding depreciation, were $71,942, to which was added $107 for non-operating income, making the gross income for the year $72,049.

The investigation disclosed that the property of the company is of capacity in excess of that needed to supply its customers up to 1920, and because of this, deductions were made by the board in arriving at its valuation for rate making purposes.

Concluding an elaborate report, the board held that the return to the gas company is not in excess of a reasonable return upon the fair value of its property used in supplying service. It remarks that the fair value thus referred to is the actual value as disclosed by the investigation and appraisement, and not the par or market value of the company's securities.

The municipalities filing the petition were Mantua Township, East Greenwich Township, Glassboro Township, Wenonah, Pitman, Clayton, Pittsgrove and Woodbury Heights, in Gloucester County; Elmer, Salem County, and Gloucester Township, Camden County.

EXPENSE OF CHANGING CHARACTER OF SERVICE.—A recent case before the Wisconsin Railroad Commission involved the responsibility of a central station company when changing the character of its service. The Janesville Electric Company originally furnished direct current service in certain parts of its territory, and later furnished alternating current service as well. In 1914 it gave notice that the direct current service would be discontinued. This is not an unusual condition, but in most cases, the companies taking this step have been able to make satisfactory arrangements with these customers who have to change from direct current to alternating current.

A consumer brought this question before the Commission, which has given a decision that seems a reasonable disposition. Since the change is in the interest of cheaper service for all, it is fair that all should pay a portion of the cost for the change; and the Commission has decided that the present value of each motor should be determined, allowing for depreciation and scrap value, and that the company shall either purchase the old motors at the price thus fixed, or if a sale can be effected elsewhere, only at a lower price, to reimburse the owner for the difference. The company's expenditures for this purpose are to be amortized in ten years and thereafter new alternating current motors are to be supplied by the user just as if he were a new customer. The ruling does not apply to concerns having isolated power plants only connected for breakdown service.

This point of view of the matter is different from that taken by the court in a recent case in Arkansas, where the conditions were similar, except that the change was from 130 cycles to 60 cycles. In that case, the court decided that the change was justified and that the company was not responsible for the expense to which consumers were put.

Financial Notes.

LARGE gains in gross and net earnings, surplus and assets are shown in the annual report of the AMERICAN LIGHT AND TRACTION COMPANY. The income statement shows gross earnings of $5,178,387.13 for the year ending December 31, 1915, an increase of $746,006.74, compared with 1914; while total expenses were $156,623.53, leaving net earnings of $5,021,763.60, a gain of $746,675.93. Dividends aggregating $4,119,462 were paid to stockholders, in contrast to $3,811,932 in 1914. Cash payments on the $14,236,200 of 6% cumulative preferred stock outstanding, were $854,172 for each year. Cash dividends of $1,632,645 and stock dividends of equal amount, equivalent to 10%, were paid on the outstanding common stock, in comparison with $1,478,880 in cash and stock distributed in 1914. The company's surplus balance, after deduction of dividends, was $10,861,339.36, an increase of $902,301.60 from December 31, 1914. An interesting feature of the statement is the announcement that while installation of 19,931 new gas meters was made in 1915, the number of new electric meters placed in service was only 4,545. Gas sales were increased by 1,183,126,300 feet, or 9.6%, while sales of electric current increased 4,201,410 kilowatt hours, or 9.32%. Outstanding preferred stock is unchanged in amount, while common stock shows an increase from $15,329,000 to $16,928,900.

THE MINNEAPOLIS GAS LIGHT COMPANY in its annual report for the year 1915, filed with the city Controller, shows gross earnings from all sources of $2,027,429.85. Expense of operations and the amount charged off for depreciation and taxes, totaled $1,374,186.39, leaving net earnings from operation of $653,243.46. Out of net earnings the company paid $320,868.11 interest on bonds and put $147,000 into the sinking fund and had $185,375.46 undivided profits. A dividend of $48,000 was paid January 7, 1915, from the earnings of the year 1914, and a dividend of a like sum was paid September 8, 1915, from the 1915 earnings. The report gives no indication of the possible effect of the lower rates now in force. The company earned $1,998,282.68 gross from sales of gas and $274,370.13 from sales of residuals. Cost of distribution amounted to $107,527, commercial expense to $135,093.29. New business totaled $39,294.14 and general expense, $75,445.98. The company put $249,862.76 into betterments and improvements during 1915, in which new mains make the greatest cost, or $165,316.26.

THE ATTLEBORO (Mass.) GAS LIGHT COPORATION has filled a petition with the State Gas and Electric Light Commission, asking the right to increase its capital stock from $58,000 to $116,000, and to issue shares, the par value of which shall be $150. The company's petition states that the increase is desired for the purpose of paying indebtedness, making alterations and additions to the buildings, machinery, plant and street mains of the company. The petition is signed by Walter T Soper, as treasurer, who is also treasurer of the Taunton Gas Light Company, while William J. Luther, who signs the attested copies of the directors and stockholders' votes, as clerk, has been the treasurer of the Attleboro company.

AT the annual meeting of the GRAND RAPIDS GAS LIGHT COMPANY, Thursday afternoon, officers were re-elected: President, Emerson McMillin, New York; vice-president, Alanson P. Lathrop, New York; vice-president and general manager, John T. Young; directors, the officers and Henry Idema, L. H. Withey, William H. Anderson, Thomas J. O'Brien, Henry Sullivan and J. Boyd Pantlind; secretary, Glenn R. Chamberlain; treasurer, John Hulswit. The company last year expended $40,000 in additions to plant and $45,000 in extensions. The appropriation for extensions the coming year will be about $50,000.

THE PACIFIC GAS AND ELECTRIC COMPANY is the seventh largest holder of water power in the country, according to a report to Congress by the department of Agriculture. Eighteen corporations are in control of more than half the water power employed in the operation of public utilities.

AT the regular monthly meeting of the board of trustees of the CONSOLIDATED GAS COMPANY recently, Charles G. M. Thomas was elected treasurer of the company to fill the vacancy caused by the death last July of Dr. James A. Bennett. Mr. Thomas is president of the New York and Queens Electric Light and Power Company, and of the Chamber of Commerce of the Borough of Queens.

THE 1915 earnings statement of STANDARD GAS AND ELECTRIC COMPANY shows a balance of $664,042, after payment of bond interest, scrip interest and allowance for interest on the new issue of $2,500,000, twenty-year, 6% gold notes, of which in excess of $2,300,000 have been purchased by investors. Earnings applicable to the notes are equivalent to more than 3½ times requirements. Comparative report of earnings for years ended November 30, 1915 and 1914 follows:

	1915.	1914.
Gross earnings	$1,525,251	$1,453,384
Expenses and taxes	42,032	37,092
Net earnings	$1,483,219	$1,416,291

The notes, which are offered by H. M. Byllesby & Company to investors at a price of 92 and interest, will retire short maturing obligations including the present outstanding 6% serial notes due June 1, 1916. Properties in which Standard Gas and Electric Company owns stock, bonds and other securities are showing substantial increases in business and earnings, to which fact is attributed the recent advances in price of the notes from 90 to 92.

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